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(71) Applicant(s)

Robert Bosch GmbH

(Incorporated in the Federal Republic of Germany)

Wernerstrasse 1, Stuttgart-Feuerbach,  
D-70442 Stuttgart 30, Federal Republic of Germany

(72) Inventor(s)

Justus Lamprecht  
Manfred Kim  
Albert Kleider  
Robert H White  
Martin G Yapp

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GB 2297871 A GB 2287288 A US 5634274 A  
US 5511942 A US 5311089 A US 3995970 A

(58) Field of Search

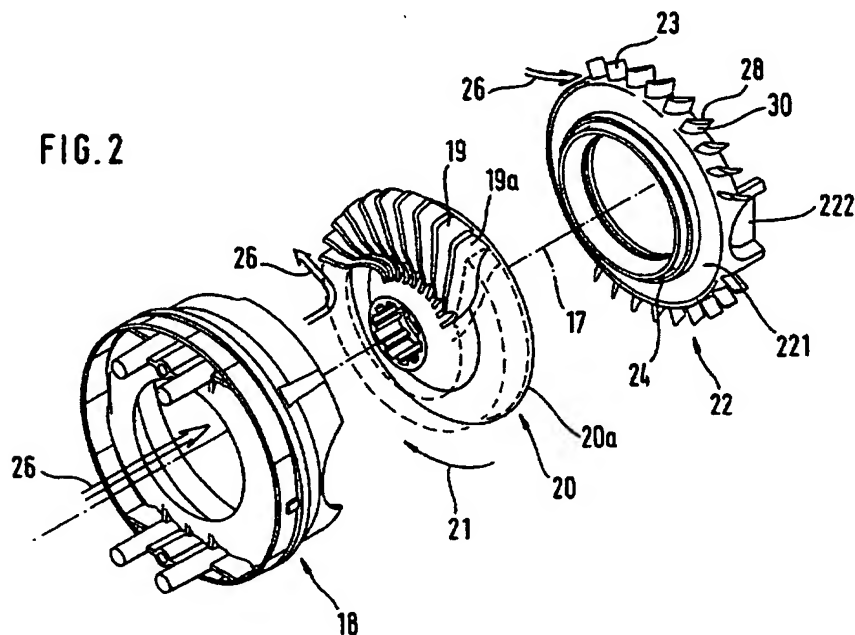
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(74) Agent and/or Address for Service

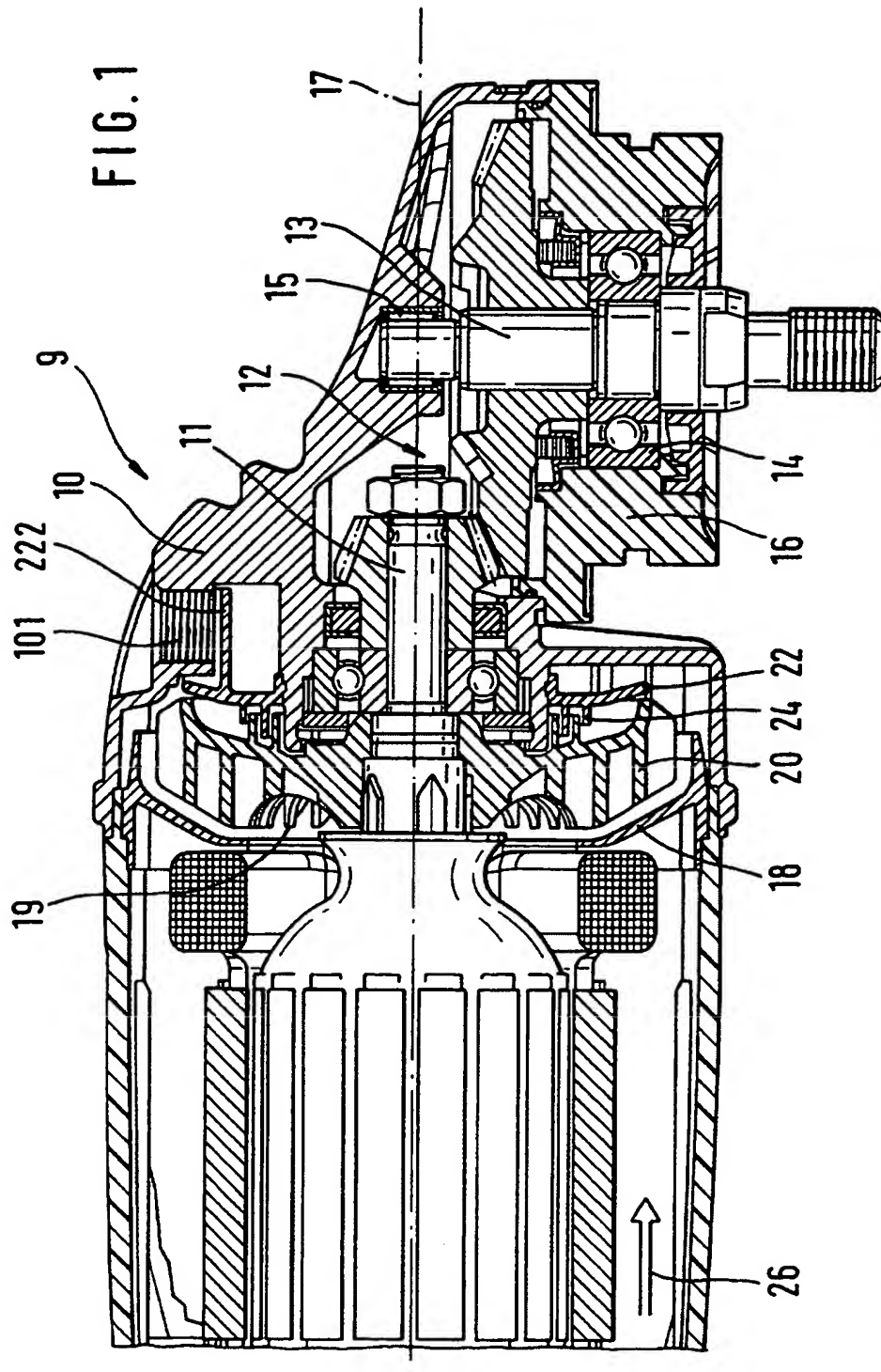
A A Thornton & Co  
Northumberland House, 303-306 High Holborn,  
LONDON, WC1V 7LE, United Kingdom

(54) Hand machine tool with cooling means

(57) A hand machine tool (9, figure 1) has a centrifugal fan impeller 20 mounted on the rotor shaft of a motor, between a stationary air guide cap 18 and air guide ring 22. The ring has blades 23 mounted on its outer surface, for directing the air flow 26 once it has left the impeller. The blades are angled to reduce swirl in the outgoing air, leading to a reduction in noise. The blades are also concave on the front side 28 and convex on the rear side 30. An air guide ring may also be provided upstream of the impeller, integrated into the air guide cap. The tool is preferably an angle grinder.



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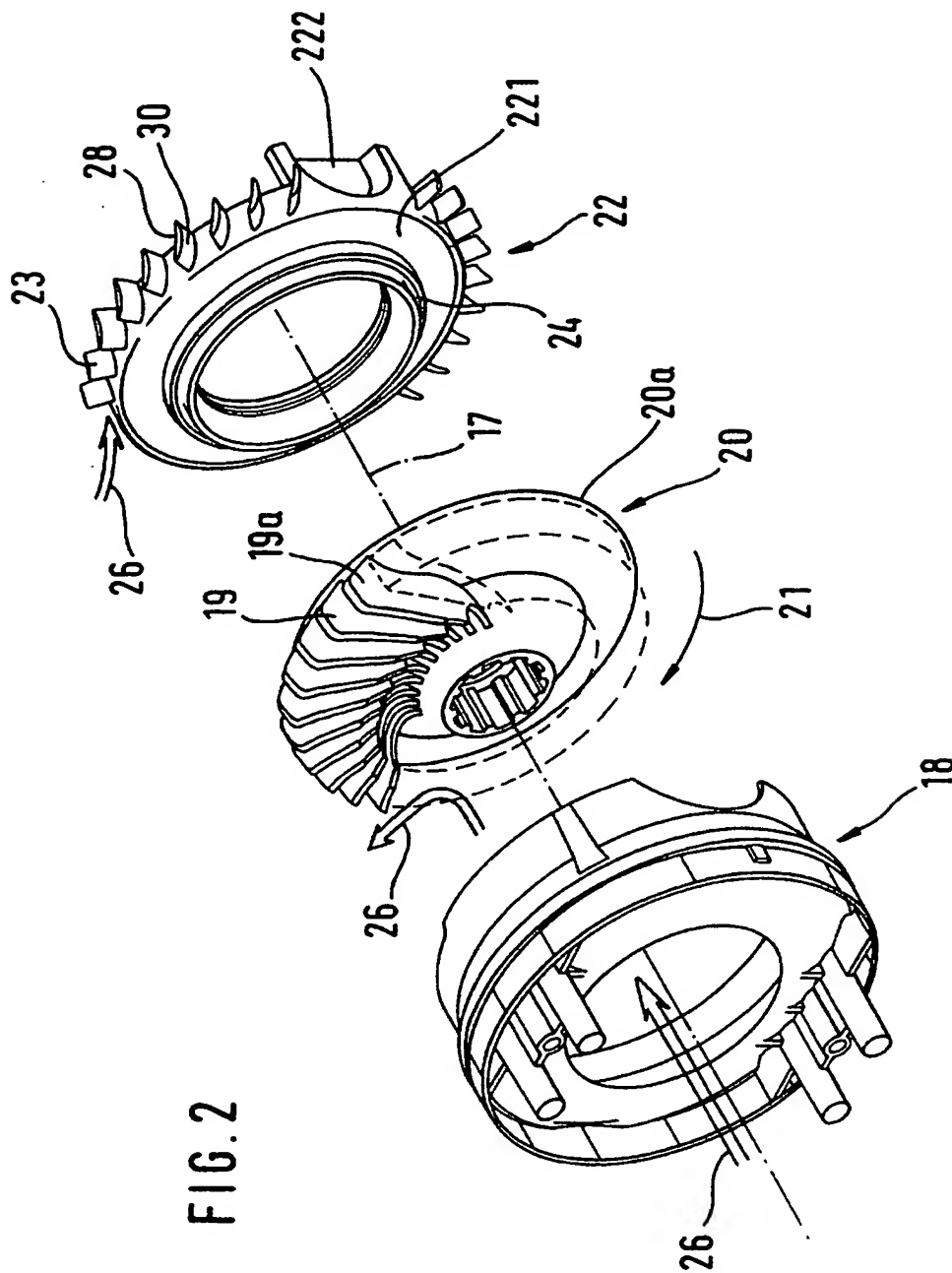


FIG. 2

**Hand machine tool****Background art**

The invention proceeds from a hand machine tool according to the type of claim 1.

From GB patent application 96 01 510.2 a hand machine tool of said type is known, the fan impeller of which is arranged so as to rotate relative to an air guide ring. The fan impeller expels, through radially outer-lying openings of the air guide ring, air which it has previously drawn over the motor for cooling the motor.

The known air guide ring is inexpensive to install but its air flow rate is limited and it does not have as positive an influence upon the noise characteristics of the fan as was originally anticipated.

From turbine construction, moreover, air guide wheels having a downstream fixed air guide ring are known, wherein for the axial air flow the air guide ring at its radially outer region adjacent to the turbine blades carries inclined air guide blades which are aligned with the air flow. Said turbines are indeed optimized in terms of their flow rate but not in terms of their noise characteristics and so they are relatively noisy.

**Advantages of the invention**

In contrast, the hand machine tool according to the invention having the characterizing features of claim 1 has the advantage that both the air flow rate and the noise characteristics are markedly improved compared to the known hand machine tools. As a result, the cooling, the energy exchange of the electric motor and hence the weight of the hand machine tool are positively influenced.

By virtue of the streamlined air guide blades of the air guide ring which are inclined in the direction of the air flow, the swirl of the air flow is reduced at the outgoing air side of the fan impeller and the air flow rate is increased while noise generation is reduced.

The air guide rings may be disposed, in air flow direction, upstream and/or downstream of the fan impeller. An air guide ring disposed, in air flow direction, axially upstream of the fan impeller reduces the swirl of the approach flow of outgoing air. As a result, more outgoing air reaches the fan impeller and the latter's energy exchange is increased. An air guide ring disposed axially, in flow direction, downstream of the fan impeller achieves, firstly, a low discharge speed and hence a reduction in noise and, secondly, a higher energy exchange.

Disposing the fan impeller between two air guide rings each having air guide blades inclined in the direction of the air flow results in a further considerable improvement in the air flow rate and a very definite reduction in noise. In said case, it is advantageous when the further air guide ring disposed upstream of the fan impeller is integrated into the air guide cap because by said means, without additional mass, the efficiency and noise characteristics of the hand machine tool are markedly improved.

#### Drawings

There follows a detailed description of an embodiment of the invention with reference to the accompanying drawings.

Of said drawings, Figure 1 is a longitudinal section of the front region of an angle grinder according to the invention and Figure 2 is an exploded view of the fan of the angle grinder motor with the air guide cap and air guide ring.

#### Description of the embodiment

The region of the angle grinder 9 shown in longitudinal section in Figure 1 comprises a machine housing 10, which accommodates an electric drive motor (not shown in detail) with rotor and with a drive shaft 11, a right-angle gear 12 and a workspindle 13. The workspindle 13 is arranged so as to be rotatably supported in a ball bearing 14 and in a needle bearing 15 at right angles to the drive shaft 11. The needle bearing 15 is accommodated by the machine housing 10 and the ball bearing 14 is accommodated by a bearing flange 16. The bearing flange 16 is flange-mounted onto the machine housing 10.

Disposed concentrically relative to the longitudinal axis 17 of the output shaft 11 and locked against rotation on said shaft is a fan impeller 20, which is positioned axially directly between an air guide cap 18 fastened non-rotatably to the machine housing 10 at the motor side and an air guide ring 22 locked against rotation at the gear side. The fan impeller 20 in a known manner carries fan blades 19 extending radially outwards with free-standing outer ends 19a and projecting out from its hub 20a.

Disposed between the end face of the fan impeller 20 and the inner periphery of the air guide ring 22 is a labyrinth seal 24 which prevents an air discharge or a pumping action in the direction of right-angle gear 12.

In its top region, the machine housing 10 carries an open threaded hole 101 for optional screw fastening of an additional handle, which is not shown. The threaded hole 101 is covered from the inside by an axial extension 222, which is disposed radially at the outside of the air guide ring 22. An undesirable escape of outgoing air up towards the operator and undesirable noise generation caused thereby is therefore avoided.

Figure 2 is an exploded view of the details of air guide cap 18, fan impeller 20 and air guide ring 22 of the angle grinder 9 according to Figure 1 and clearly shows uniformly spaced air guide blades 23 on two peripheral regions of the annular body 221 of the air guide ring 22 as well as, between said regions, an extension 222 for covering the threaded hole 101. It is moreover evident that the air guide blades 23 are each provided in a streamlined manner with a concave side 28 and a convex side 30 and that they are arranged inclined relative to the longitudinal axis 17 in such a way as to lie in the outgoing air flow at the level of the free-standing outer ends 19a of the fan blades 19 which project from the hub 20a.

A first arrow 21 indicates the direction of rotation of the fan impeller 20. Further direction arrows indicate the air flow direction 26 in Figures 1 and 2.

As the fan impeller 20 rotates in the direction of rotation of arrow 21, it feeds air radially and in a peripheral direction towards the outside and pumps said air with an axial flow component in direction of rotation according to arrow 26 via the air guide blades 23 and out through suitable openings (not shown) in the machine housing 10. The motor, which is not described in detail, is through-ventilated because air accelerated radially outwards from the middle of the fan impeller 20 according to the air direction arrow 26 has been drawn in previously in such a way that it sweeps over the motor.

By inclining the air guide blades 23 in such a way that their region facing the fan impeller 20 is displaced counter to the direction of rotation 21 and their region remote from the fan impeller 20 is displaced in the direction of rotation 21 of the fan impeller 20 relative to the longitudinal axis 17, a swirl-free removal of the outgoing air is achieved. The air flow rate with such air guide blades is distinctly better than with air guide blades disposed parallel to the longitudinal axis 17, a considerable further reduction in noise being achieved by the streamlined design of the cross section of the air guide blades 23. Given said design, the air accelerated by the fan impeller 20, on the one hand, impacts the slightly concave front sides 28 of the air guide blades 23 and, on the other hand, slides along the rear side 30 which has a more strongly convex curvature, thereby moderating air whirls and leading to a high air flow rate with minimal noise generation.



**Claims**

1. **Hand machine tool having an electric motor, which is disposed in a machine housing and the rotor of which has an output shaft, which carries and rotatably drives a fan impeller provided with fan blades, the machine housing containing a right-angle gear and the fan impeller being disposed in the machine housing directly between a non-rotatable air guide cap and a non-rotatable air guide ring, characterized in that the air guide ring in its outer region carries air guide blades, which are each arranged axially inclined, particularly in a uniformly spaced manner, relative to the longitudinal axis of the output shaft and lie at the level of the, in particular free-standing, outer ends of the fan blades.**
2. **Hand machine tool according to claim 1, characterized in that the air guide blades run straight in a radial direction and are curved in an axial direction.**
3. **Hand machine tool according to claim 2, characterized in that the air guide blades, which are preferably disposed only over sub-regions of the outer periphery of the air guide ring, extend radially above the hub of the fan impeller.**
4. **Hand machine tool according to claim 2 or 3, characterized in that the region of the air guide blades remote from the fan impeller is offset forward in the direction of rotation of the fan impeller and that the region of the air guide blades facing the fan impeller is offset counter to the direction of rotation of the fan impeller in such**

a way that determines the inclination of the air guide blades relative to the longitudinal axis of the air guide ring in the direction of the air flowing off from the fan impeller.

5. Hand machine tool according to claim 4, characterized in that the air guide blades, viewed in the direction of rotation of the fan impeller, have a concave front side and a more strongly convex rear side.
6. Hand machine tool according to one of the preceding claims, characterized in that the air guide ring on its radial annular body carries at least one axially forward-projecting extension, which is used to cover openings in the machine housing.
7. Hand machine tool according to one of the preceding claims, characterized in that an air guide ring with inclined air guide blades is disposed upstream and/or downstream of the fan impeller, the one upstream of the fan directing the intake air and the other directing the discharged air.
8. Hand machine tool according to claim 7, characterized in that the air guide ring disposed upstream of the fan impeller is disposed non-rotatably on the air guide cap.
9. Hand machine tool according to claim 8, characterized in that the air guide ring disposed upstream of the fan impeller is integrated into the air guide cap.

10. A hand machine tool substantially as herein described with reference to the accompanying drawings.



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Claims searched: 1-10

Examiner: Peter Emerson  
Date of search: 25 February 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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29/52, 29/54, 29/32, 19/00

Other:

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A, Y	GB 2297871 A (BOSCH)	1-5, 7-9
Y	GB 2287288 A (WEIR) - fig 1.	1-3, 7
A, Y	US 5634274 A (MAKITA) - fig 4.	1-5, 7-9
Y	US 5511942 A (MICRONEL) - fig 1.	1-4, 7
Y	US 5311089 A (BOSCH) - figs 1, 2.	1-5, 7-9
Y	US 3995970 A (MITSUBISHI) - fig 5.	1, 7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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